Letters to the Editor

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Is There Any Advantage to Using an Arterial Transfer Function?

To the Editor:

We read with interest the paper by Millasseau et al,1 which raises the question of whether the application of an arterial transfer function to noninvasively acquired radial artery pressure waveform data is necessary for the estimation of central aortic waveform characteristics. Although the conclusion that this approach offers no advantage over the simple analysis of untransformed radial artery pressure waveforms is valid, it should be remembered that the approach of these authors demonstrates only comparability and does not add to the debate as to whether arterial transfer function techniques enable accurate estimation of central aortic waveform parameters, because no directly measured central aortic waveforms were available for comparison.

Our own findings, derived from noninvasive radial waveforms compared with directly measured central aortic waveforms, have demonstrated close relationships between several radial and measured central aortic waveform parameters proposed to be of potential clinical value, such as systolic and diastolic pressure time integrals.2,3 However, the radial artery augmentation index (AI) was unrelated to, or at best weakly correlated with, the directly measured central aortic AI.2,3 The poor correlation and wide limits of agreement between directly measured central aortic and transfer function–derived AI observed by most authors is explained by the persisting close correlation between the radial AI and that derived by the application of a generalized transfer function to this data, which has been confirmed by Millasseau et al.1,3–6 Those who have reported correlation between measured and derived values have done so using combined data sets including repeated data from each individual before and after an intervention.7,8 Given that such repeated values are correlated within the individual (Sarah A. Hope, Ian T. Meredith, James D. Cameron, unpublished observations), this practice will falsely strengthen any underlying correlation or indeed create an apparent statistical correlation where no such correlation exists in the baseline data. Millasseau and colleagues have demonstrated changes in the radial AI with interventions that are correlated with the AI of the waveform derived by the application of an arterial transfer function to the same data.1 As we have previously noted and is reiterated in the editorial accompanying this paper, given that the radial artery waveform contains all the data utilized to synthesize the transfer function–derived waveform, this is not surprising.9,10 These findings do not, however, indicate that measured central aortic AI is necessarily changing in the same manner.

Much confusion surrounds the use of arterial transfer function techniques. With the substantial equivalence between radial waveform parameters and transfer function–derived parameters, much of this confusion might be alleviated by the analysis of untransformed radial waveforms. This approach would also have the advantage that it would dispel the myth that what is being analyzed is a true central aortic waveform rather than simply the result of the application of a low-pass filter to a radial pressure waveform.9 We would therefore support the conclusions of Millasseau and colleagues that the simple analysis of untransformed radial pressure waveforms, in preference to transfer function–derived waveforms, should be considered for the potential to add to the conventional approaches for cardiovascular risk stratification and treatment.


Response: Aortic Augmentation Index and Radial-to-Aortic Transfer Function

We thank Hope and colleagues for their comments on our recent study reporting poor agreement between aortic augmentation index (AIx) derived by applying transfer functions (TF) to the carotid and radial pressure waveforms.1–2 They correctly emphasize that our study was comparative and did not identify whether inaccuracies in the radial-to-aortic TF or in the carotid-to-aortic TF or both were responsible for the variation in aortic AIx obtained from the transformed carotid and radial waveforms. We did, however, suggest that the majority of the error was likely to result from the radial-to-aortic TF because of the similarity between carotid and aortic waveforms. In a study that was in press at the time our paper was published, Hope and colleagues have now compared values of aortic AIx obtained using a radial-to-aortic TF with direct invasive measurements.3 They find little, if any, relationship between measured values of aortic AIx and values estimated from the radial artery using a TF, confirming the poor performance of a radial-to-aortic TF in estimating aortic AIx. Their study was performed in older subjects (mean age 63±10 years) undergoing cardiac catheterization. It is unlikely that better results would have been obtained in younger subjects because, in our comparative study, we found no correlation between aortic AIx obtained from transformed
carotid and radial waveforms in young healthy subjects. The new data provided by Hope and colleagues provides convincing evidence that a radial-to-aortic TF does not provide an accurate measurement of aortic AIx. The purpose of a TF is to aid with the interpretation of a measurement; it cannot add any information. The radial-to-aortic TF improves the evaluation of systolic blood pressure by providing an estimation of central systolic blood pressure. By contrast, in the case of aortic AIx, the TF offers little advantage: the transformed radial pulse may provide useful information about pressure wave reflection (as does the untransformed pulse) but does not tell us about true aortic AIx. We are in complete agreement with Hope and colleagues that simple analysis of the untransformed radial pulse may lead to less confusion when assessing wave reflection.

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